Europäisches Patentamt

EUROPÄISCHER RECHERCHENBERICHT

Nummer der Anmeldung
EP 02 40 6100

EINSCHLÄGIGE DOKUMENTE

Kategorie	Kennzeichnung des Dokuments mit Angabe, soweit erforderlich, der maßgeblichen Teile	Betrifft Anspruch	KLASSIFIKATION DER ANMELDUNG (Int.Cl.7)
X	WO 02 14198 A (KONE CORP ;KONTTURI RISTO (FI); JONG JOHANNES DE (FI); SIIKONEN MA) 21. Februar 2002 (2002-02-21) * das ganze Dokument *	1-16	B66B1/20
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X	US 4 838 385 A (EKHOLM RALF) 13. Juni 1989 (1989-06-13) * das ganze Dokument *	1-16	
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A	PATENT ABSTRACTS OF JAPAN vol. 018, no. 245 (M-1603), 11. Mai 1994 (1994-05-11) & JP 06 032544 A (TOSHIBA CORP), 8. Februar 1994 (1994-02-08) * Zusammenfassung *	1-16	RECHERCHIERTE SACHGEBIETE (Int.Cl.7) B66B

Der vorliegende Recherchenbericht wurde für alle Patentansprüche erstellt

Recherchenort	Abschlußdatum der Recherche	Prüfer
MÜNCHEN	14. April 2003	Trimarchi, R

KATEGORIE DER GENANNTEN DOKUMENTE

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EPO FORM 1503 03.82 (P04C03)

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Express Mail Label
No. EV343678509 US

ANHANG ZUM EUROPÄISCHEN RECHERCHENBERICHT ÜBER DIE EUROPÄISCHE PATENTANMELDUNG NR. EP 02 40 6100

In diesem Anhang sind die Mitglieder der Patentfamilien der im obengenannten europäischen Recherchenbericht angeführten Patentdokumente angegeben.
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14-04-2003

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Für nähere Einzelheiten zu diesem Anhang : siehe Amtsblatt des Europäischen Patentamts, Nr.12/82

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No. EV343678509 US

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Europäisches Patentamt	European Patent Office	Office européen des brevets
Zweigstelle in Den Haag Recherchenabteilung	Branch at The Hague Search division	Département à La Haye Division de la recherche

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28. April 2003
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FH - LW

Datum/Date
28.04.03

Zeichen/Ref./Réf.	Anmeldung Nr/Application No./Demande n°/Patent Nr./Patent No./Brevet n°
IP 1414/PA/An	02406100.4-2316

Anmelder/Applicant/Demandeur/Patentinhaber/Proprietor/Titulaire
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MITTEILUNG

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Die folgende Abbildung wird mit der Zusammenfassung veröffentlicht: 1

RÜCKERSTATTUNG DER RECHERCHENGEBÜHR

Falls Artikel 10 der Gebührenordnung in Anwendung kommt, ergeht noch eine gesonderte Mitteilung der Eingangsstelle hinsichtlich der Rückerstattung der Recherchengebühr.

Express Mail Label
No. EV343678509 US

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
21 February 2002 (21.02.2002)

PCT

(10) International Publication Number
WO 02/14198 A1

(51) International Patent Classification[7]: B66B 1/20

(21) International Application Number: PCT/FI01/00574

(22) International Filing Date: 15 June 2001 (15.06.2001)

(25) Filing Language: Finnish

(26) Publication Language: English

(30) Priority Data:
20001664 14 July 2000 (14.07.2000) FI

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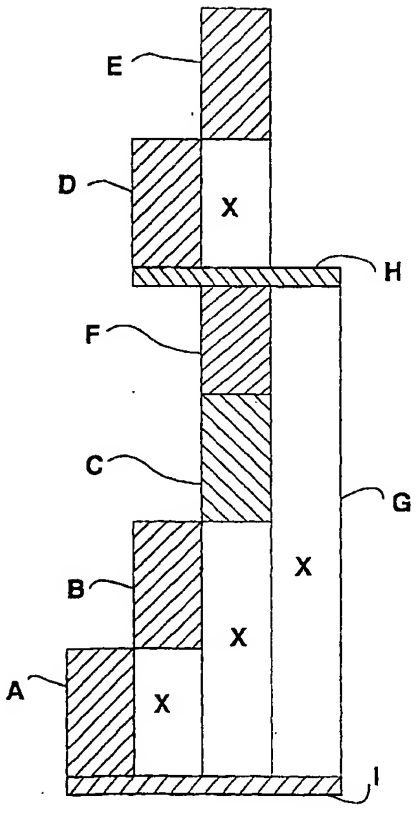
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European

[Continued on next page]

(54) Title: METHOD FOR CONTROLLING TRAFFIC AT A CHANGE FLOOR



(57) Abstract: Method for organizing the operation of elevator groups in a building having one or more sky lobbies (H) serving as an entrance floor for local elevator groups disposed above and below them and serving given floors, and as a terminal floor for at least one shuttle elevator group (G) transporting passengers from the entrance floor (I) of the building to a sky lobby (H), in which method congestion of traffic at the sky lobby (H) is prevented by using a group control system.

WO 02/14198 A1

patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Published:
— *with international search report*

METHOD FOR CONTROLLING TRAFFIC AT A CHANGE FLOOR

The present invention relates to a method according to patent claim 1 for controlling traffic in elevator groups.

High-rise buildings often have several elevator groups, and it is necessary to develop a system for the control of traffic between different elevator groups to ensure that they can operate even in abnormal situations. A frequent problem in high-rise buildings is also that, especially for passengers changing from one elevator group to another, the waiting times may become too long in congestion situations, which impairs the performance of the elevator system.

High-rise buildings having more than 40-50 floors often comprise one or more change floors (sky lobbies) which are only served by certain elevator groups. In this case, the building is divided into at least two sections, depending on the number of change floors. The elevator groups are often divided into zones in the direction of elevation of the building, in which case a given destination can only be reached using elevators belonging to a given zone. Local elevator groups serve each floor within their respective zones. The building may also contain express zones where elevators travel past several floors without stopping. The lower section up to the sky lobby is served by local elevator groups in their respective zones and the upper section above the sky lobby is served by a corresponding system with local elevator groups. Passengers reach the sky lobby directly from the ground floor by using shuttle elevators, which do not stop at any other floors.

Congestion of traffic may become a problem at a sky lobby when the transportation capacity of an elevator group is too low for some reason. The supply traffic to the sky lobby should be in balance with the traffic leaving the floor. Congestion arises e.g. in the morning when passengers arrive in the building if in this situation elevators are missing from the local elevator groups. Congestion also arises in situations where shuttle elevators are out of use and the outgoing traffic in the building is heavy. In the event of an exceptional situation involving heavier traffic than during normal incoming and outgoing peak traffic, e.g. evacuation of passengers from the building because of a fire, earthquake or bomb scare, congestion is likely to occur at the sky lobby.

According to US patent 4838385, an algorithm has been created which coordinates the arrivals and departures of elevators at a sky lobby so that the amount of time spent on changing elevators is minimized. The object of the invention is to minimize the combined waiting times in the building. According to specification US 5785153, elevators arriving at the sky lobby are synchronized in order that the shuttle elevators and the local elevators should be at the sky lobby at the same time. According to the invention, this is achieved by controlling the elevator speeds or by delaying an elevator by keeping its doors open longer than usual. Calls for elevators can also be cancelled or avoided. According to the specification, empty elevators can be kept waiting in the upper part of the building or they may be directed to the ground floor.

The object of the invention is to create a new type of method for organizing the operation of elevator groups so that a balance prevails between the traffic leaving

a sky lobby and the traffic arriving at it in a situation of exceptionally bad congestion.

As for the features characteristic of the invention, reference is made to the claims.

According to a preferred embodiment of the invention, the congestion of traffic occurring at the sky lobby in an exceptional situation is controlled by considering the traffic between different elevator groups. One of the advantages of the invention is that, by using the arrangement of the invention, a congestion situation preferably at a sky lobby can be brought under control. The idea is to maintain the traffic supplied to the sky lobby at the same level of intensity as the traffic leaving the sky lobby even when the transportation capacity of a local group or shuttle group has been momentarily reduced. According to a preferred embodiment of the invention, the operation of elevator groups in buildings having one or more sky lobbies is so organized that congestion of traffic at the sky lobby is prevented via a group control system.

The group control system of the invention collects traffic data for the whole building both from local and shuttle elevator groups and is therefore aware of the traffic situation in the entire building. According to a preferred embodiment of the invention, using a traffic forecaster comprised in the group control system, the system prepares a forecast regarding congestion occurring on the entrance floor and the sky lobby and identifies the traffic type of the building. According to a preferred embodiment, local elevator groups and shuttle elevator groups monitor the number of passengers entering and leaving the elevator cars by means of light cells and car load weighing devices.

The traffic data are sent to a control procedure according to the invention which generates building-specific statistics. The group control system collects passenger traffic data from different elevator groups in order to prepare a forecast regarding queue build-up in sky lobbies and on the entrance floor. Using the traffic forecaster comprised in the control system, the latter computes a forecast of the queue of passengers being built up in the sky lobby and preferably identifies the traffic type prevailing in the building, which information is used as a basis for dividing the elevator groups into different traffic service classes (TSC classes) in order to regulate the acceleration, velocity and stopping time of the elevator groups so as to balance the traffic at the sky lobby. The congestion of traffic at the sky lobby can also be advantageously prevented by returning all unoccupied elevators to a floor where traffic is becoming congested, unoccupied elevators being empty elevators that have not been allocated to serve calls by other passengers. To retard an elevator group, some elevators are excluded from appropriate elevator groups.

If the transportation capacity of a shuttle elevator group is insufficient to handle the amount of traffic to be supplied to the sky lobby within a given span of time in a down-peak traffic situation, then the following modes of action are applied to avoid congestion. In local elevator groups supplying traffic to the sky lobby, some elevators can be excluded from service or their degree of admission can be reduced, which means that these elevators are operated with cars not completely filled. In addition, the stopping times of the elevators can be increased and their acceleration or maximum speed can be reduced as required in the prevailing situation. Correspondingly, the

shuttle elevators must be caused to leave the sky lobby sooner in a down-peak traffic situation, which according to the invention is accomplished as follows. The acceleration or maximum speed of the shuttle elevator groups is increased, and the service level for traffic against the direction of peak traffic is lowered. Some or all of the unoccupied shuttle elevators are returned to the sky lobby.

According to a preferred embodiment, in mixed traffic consisting of incoming and outgoing traffic as well as inter-floor traffic, the acceleration and speed of all elevator groups are increased.

According to a second preferred embodiment of the invention, in an up-peak traffic situation as passengers want to get from the entrance floor to upper floors and congestion is to be expected at the sky lobby, the following procedure is adopted. The acceleration and top speed of local elevators are increased or their stopping time is reduced for the upper floors or the service level for downward traffic is lowered. The transportation capacity of shuttle elevators is reduced by increasing e.g. the stopping time or by reducing the speed or acceleration of the elevators. In the case of bad congestion at the sky lobby, some of the shuttle elevators can also be excluded from the group.

In the following, the invention will be described in detail with reference to the attached drawings.

- Fig. 1 illustrates an elevator group system as used in very high buildings.

- Fig. 2 visualizes the method of the invention as a block diagram.

- Fig. 3 represents the mode of action according to the invention in a down-peak situation in a building.

Fig. 1 shows how the elevator groups are arranged in a high-rise building. In the building illustrated in the figure, local elevator groups A, B, C, D, E and F are in operation, each serving a number of floors within its respective zone. One local elevator group may comprise e.g. 4-8 elevators. The floors marked with X are express zones of local elevator groups where the elevators do not stop at all. A change floor H (sky lobby) divides the building into two sections, forming the destination for shuttle elevators G departing from the entrance floor I. At the same time, the sky lobby H constitutes an entrance floor for the local elevator groups departing from that floor. Local elevator group F only serves passengers going downward from the sky lobby H. Passengers going upward from the sky lobby H are served by elevator groups D and E, which have been arranged in a manner corresponding to groups A, B, C. The elevators in the shuttle elevator group G operate only between the entrance floor I and the sky lobby H without stopping at the other floors.

The group control system of the invention is called META. Fig. 2 shows the connections between the META group control system of the invention and other factors controlling the elevator groups. The META group control system has been developed to control congestion at a sky lobby in abnormal situations, such as situations where elevators are out of use or when the building is being evacuated because of a danger. The META group control unit collects measured traffic data

from each local elevator group. Each local elevator group and each shuttle elevator group also has its own traffic forecaster supplying information to the META control unit. In addition to the measured instantaneous data, the META group control system of the invention also comprises a traffic forecaster which produces a forecast of future loading of the elevator groups in the entire building. The META control system is continuously informed of the traffic prevailing in the building and, based on this information, it prepares a forecast regarding congestion at the sky lobby. META is a computer control unit supervising the operation of the elevators on different floors on the basis of traffic data collected from all the elevator groups. The control unit also monitors queue build-up on the entrance floor and at the sky lobby on the basis of the number of passengers arriving and leaving the floor, and registers the data. If congestion is to be expected, then the META control system estimates the traffic type in the building and, in a situation differing from normal peak traffic congestion, directs elevator groups into different TSC classes (TSC = traffic service class) in order to clear the congestion situation.

When queue build-up is detected at the sky lobby, which in high-rise buildings functions as an entrance floor for the local elevator groups operating above and below it, the META control unit directs the groups into different service classes depending on the traffic type prevailing in the building. The various elevator groups are divided simultaneously into different TSC classes according to whether the service provided by the elevator group in question should be retarded or accelerated to avoid congesting traffic at the sky lobby. Table 1 presents a division into different TSC

classes. On the basis of the TSC classes, the META system makes changes for certain elevators regarding acceleration, velocity and stopping times, including the door open time and speed of door opening and closing (door performance class).

TABLE 1. TSC classes in the META control system

TSC CLASSES	ELEVATOR ACCELERATION/door performance class
Smooth	0,8–0,9 m/s^2 / comfortable
High	1,1–1,2 m/s^2 / top
Normal	1,0 m/s^2 / high

Table 2 presents different traffic types. Different traffic types in the building vary depending on the situation, and they are used by the META control system as a basis for dividing elevator groups into TSC classes to avoid congestion. Down-peak traffic refers to traffic from upper floors to the exit floor. Up-peak traffic means traffic from the entrance floor to upper floors. Inter-floor traffic takes place between upper floors, so none of these passengers arrive at or depart from the entrance floor of the building. Mixed traffic consists of incoming, outgoing and inter-floor traffic components. When no queues are detected, the situation is described as light or normal traffic, and the elevators are operated without the action of META control. According to the traffic type prevailing in the building, the system determines whether unoccupied elevators are to be returned to floors where they are needed, whether elevators are to be excluded from a group, or whether the operation and stopping times of the elevators are to be accelerated or retarded.

TABLE 2. Different traffic types in a building

TRAFFIC TYPES

Down-peak traffic
Up-peak traffic
Mixed traffic
Light and normal traffic

In the case of heavy down-peak traffic, the META system assigns the local elevator groups the TSC class 'smooth', and in this case their acceleration is lowered to a value between 0.8 - 0.9 m/s^2, the speed is reduced and the stopping times are increased a little (door performance class = comfortable, Table 1) in order to reduce the number of people arriving at the sky lobby. It is possible to exclude local elevators from operation or reduce their degree of admission, in which case the elevators will be running with cars not completely filled. Correspondingly, the TSC class parameter for the shuttle elevators is assigned the value 'high', which means that their acceleration is increased to the value of 1.1-1.2 m/s^2, their speed is increased and unoccupied shuttle elevators are returned under META control to the congested floor. In addition, the stopping times for the shuttle elevators are shortened (door performance class = top, Table 1).

When up-peak traffic prevails in the building, there is a relatively large number of passengers wanting to go up from the entrance floor, so that congestion is to be expected. If some elevators in the local groups are out of use, then the operation of the shuttle elevators is retarded and the service provided by the local group is accelerated. The acceleration of local elevator groups is increased to 1.1-1.2 m/s^2 (TSC high), their speed is increased and the stopping time for the elevators at the upper floors is shortened, thus also accelerating the operation of the doors. The

level of service provided by local elevators is reduced for traffic in the direction opposite to the peak traffic direction, i.e. for downward traffic. The service provided by the shuttle group is retarded by reducing the elevators to service class 'smooth', and in a heavily congested situation shuttle elevators can be excluded from the group. In normal up-peak conditions, the elevators operate without the action of META group control, unoccupied elevators being returned to the entrance floor. If heavy mixed traffic prevails in the building, then the service class (TSC class) of all elevator groups is raised to the value 'high', which means that their acceleration will be 1.1- 1.2 m/s^2 and the maximum speed is increased.

When no congestion is detected in the sky lobby, all elevator groups are again classified into TSC class 'normal' (door performance class = high, Table 1). During normal traffic, the shuttle elevators are returned to floors where the forecast produced by the META control system foresees congestion of traffic. In this case, an elevator leaving the sky lobby is accelerated and an elevator arriving there is retarded.

The META control system displays traffic congestion information via a building monitoring system, thus informing the building manager about congestion situations. Information relating to congestion and empty elevators can also be displayed via floor-specific monitors and via display devices placed inside elevator cars (showing e.g. texts like 'room left', 'full' or 'congestion on intermediate floor'. The control systems of all different elevator groups communicate with the META control system, informing it about the state of the elevators and the numbers of people leaving and arriving at different floors. The number of

passengers entering and leaving the cars is measured using data obtained from load weighing devices and light cells mounted in the cars. Congestion in the lobby is ascertained using lobby detectors.

The door operation speeds are also controlled in accordance with the TSC classes. Generally, it can be stated that, in a congestion situation, the stopping time of elevators is shorter and therefore the open time of the doors and their opening and closing times are shortened on other floors except the congested floors. When adjusting these, it is necessary to take traveling comfort into account. Although traffic is often congested on the entrance floor, relatively long stopping times and normal door speeds should be applied because the number of passengers is also large.

Fig. 3 visualizes a building with a sky lobby H and elevator groups 20, 21 and 22 departing from it. Elevator group 20 serves floors below the sky lobby. The arrows in the figure indicate the traveling direction in a situation where exceptionally heavy down-peak traffic prevails in the building and the only way to get out of the building to the street level I is to use the shuttle group 22. In a down-peak traffic situation, a considerable number of passengers are trying to get to the exit floor and the traffic may become congested because of the elevator groups trying to reach the sky lobby. Using the procedure of the invention, elevator groups 20 and 21 serve passengers going to the sky lobby H, and to reduce the number of passengers arriving there it is possible to exclude some elevators from groups 21 or 20 or operate the elevators with a lower degree of admission, i.e. with cars not completely filled. The arrivals of elevator groups 21 and 20 at the sky lobby H can also be re-

tarded by influencing their stopping times, i.e. also the speed of opening and closing of elevator doors and the length of time the doors remain open, or by reducing the acceleration of the elevators or by lowering their top speed. The speed of service of the shuttle elevators 22 from the sky lobby can be increased by automatically returning unoccupied elevators there without an external call. Other expedients for accelerating the arrival of elevators 22 at floor I include increasing the acceleration of the elevators, increasing the top speed, lowering the level of service for incoming traffic of people traveling from the ground floor I to upper floors in the building.

It is obvious to the person skilled in the art that different embodiments of the invention are not limited to the example described above, but that they may be varied within the scope of the claims presented below.

CLAIMS

1. Method for organizing the operation of elevator groups in a building having one or more sky lobbies (H) serving as an entrance floor for local elevator groups disposed above and below them and serving given floors, and as a terminal floor for at least one shuttle elevator group (G) transporting passengers from the entrance floor (I) of the building to a sky lobby (H), **characterized** in that congestion of traffic at the sky lobby (H) is prevented by using a group control system.

2. Method as defined in claim 1, **characterized** in that traffic data for all elevator groups (A-G, Fig. 1) in the building are collected into the group control system.

3. Method as defined in claim 1 or 2, **characterized** in that, using a traffic forecaster comprised in the group control system, the system prepares a forecast regarding congestion occurring on the entrance floor (I) and at the sky lobby (H) and identifies the traffic type of the building.

4. Method as defined in any one of the preceding claims, **characterized** in that the local elevator groups (A-F, Fig. 1) and the shuttle elevator group (G) monitor the number of passengers entering and leaving the elevator cars by means of light cells and car load weighing devices.

5. Method as defined in any one of the preceding claims, **characterized** in that the group control system collects passenger traffic data from different elevator groups in order to prepare a forecast

regarding queue build-up in the sky lobby (H) and on the entrance floor (I) of the building.

6. Method as defined in any one of the preceding claims, **characterized** in that the elevator group control system infers the prevailing building-specific traffic type from the passenger traffic data received from different elevator groups.

7. Method as defined in any one of the preceding claims, **characterized** in that, when the sky lobby (H) or the entrance floor (I) becomes congested, the elevator groups (A-G, Fig. 1) are divided in accordance with the building-specific traffic type into different service classes, and the acceleration, speed and stopping time of the elevator groups are adjusted in accordance with said service classes to balance the traffic at the sky lobby (H).

8. Method as defined in claim 1, **characterized** in that the level of service of the building is improved by returning unoccupied empty elevators which have not been allocated to serve calls by other passengers to the entrance floor of the building or to upper congested floors.

9. Method as defined in claim 1, **characterized** in that some of the elevators in the building are excluded from the group in order to retard the operation of the elevator group.

10. Method as defined in any one of the preceding claims, **characterized** in that, in a down-peak traffic situation with many passengers wanting to get from upper floors to the exit floor, one or more of

the following actions are adopted: some elevators in the local elevator groups are excluded from operation and operated with cars not completely filled, the acceleration and speed of the elevators are reduced and their stopping times at the floors is increased to reduce the number of passengers trying to get to the sky lobby.

11. Method as defined in any one of the preceding claims, **characterized** in that, in a down-peak traffic situation with many passengers wanting to get from other floors to the exit floor, one or more of the following actions are adopted: the acceleration and speed of the shuttle elevator groups departing from the sky lobby are increased and their stopping times are shortened and some or all of the unoccupied shuttle elevators are automatically returned to the congested floor to increase the number of passengers leaving the sky lobby.

12. Method as defined in any one of the preceding claims, **characterized** in that, in mixed traffic consisting of incoming and outgoing traffic as well as inter-floor traffic, the acceleration and speed of at least one elevator group are increased.

13. Method as defined in any one of the preceding claims, **characterized** in that in an up-peak traffic situation with congestion occurring at the sky lobby and passengers wanting to get from the entrance floor to upper floors, one or more of the following actions are adopted: the acceleration and top speed of the local elevators are increased, their stopping times are shortened or their level of service for downward traffic is lowered to in-

crease the transportation capacity of the elevators.

14. Method as defined in any one of the preceding claims, characterized in that, in an up-peak traffic situation with congestion occurring at the sky lobby and passengers wanting to get from the entrance floor to upper floors, one or more of the following actions are adopted: the speed and acceleration of the shuttle elevators are reduced, the stopping times are increased or elevators are excluded from operation.

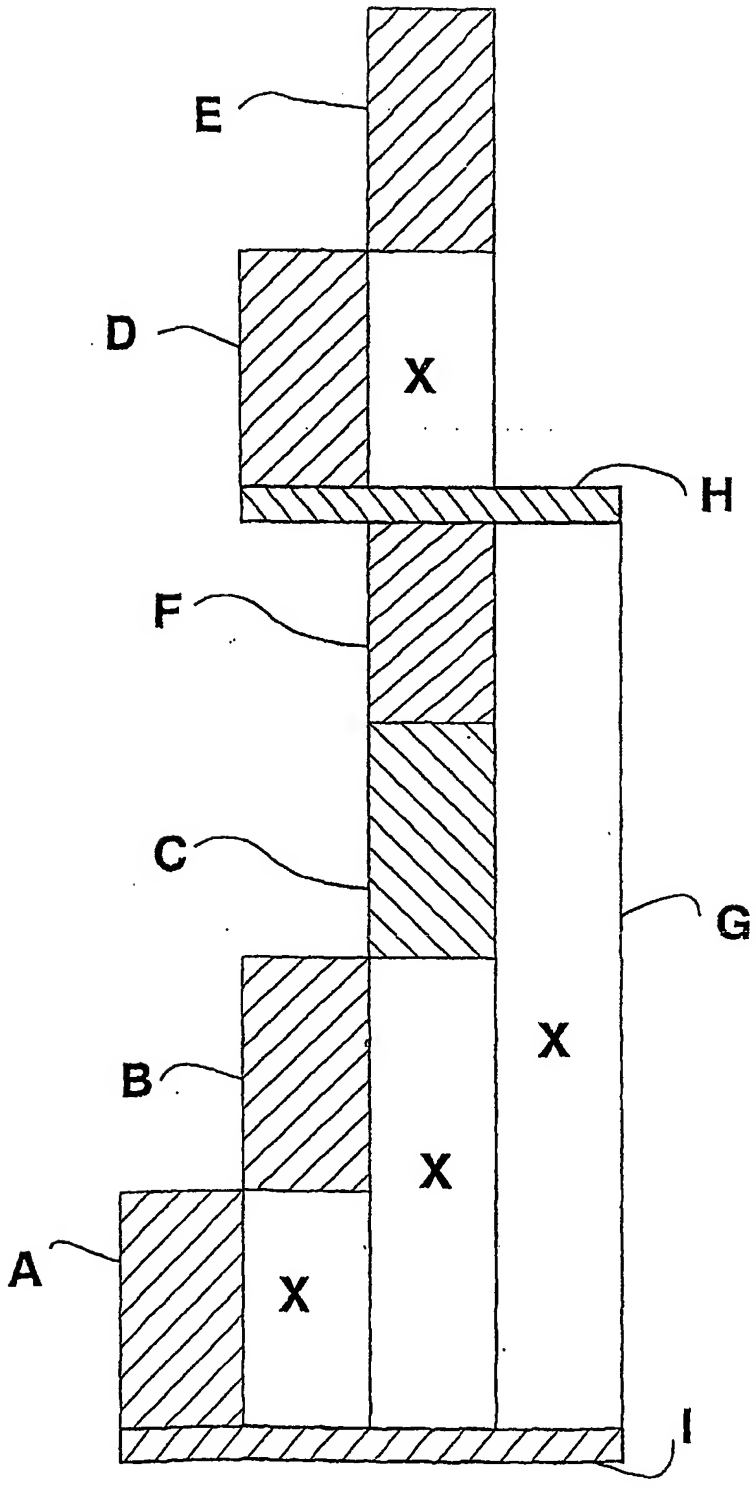


Fig. 1

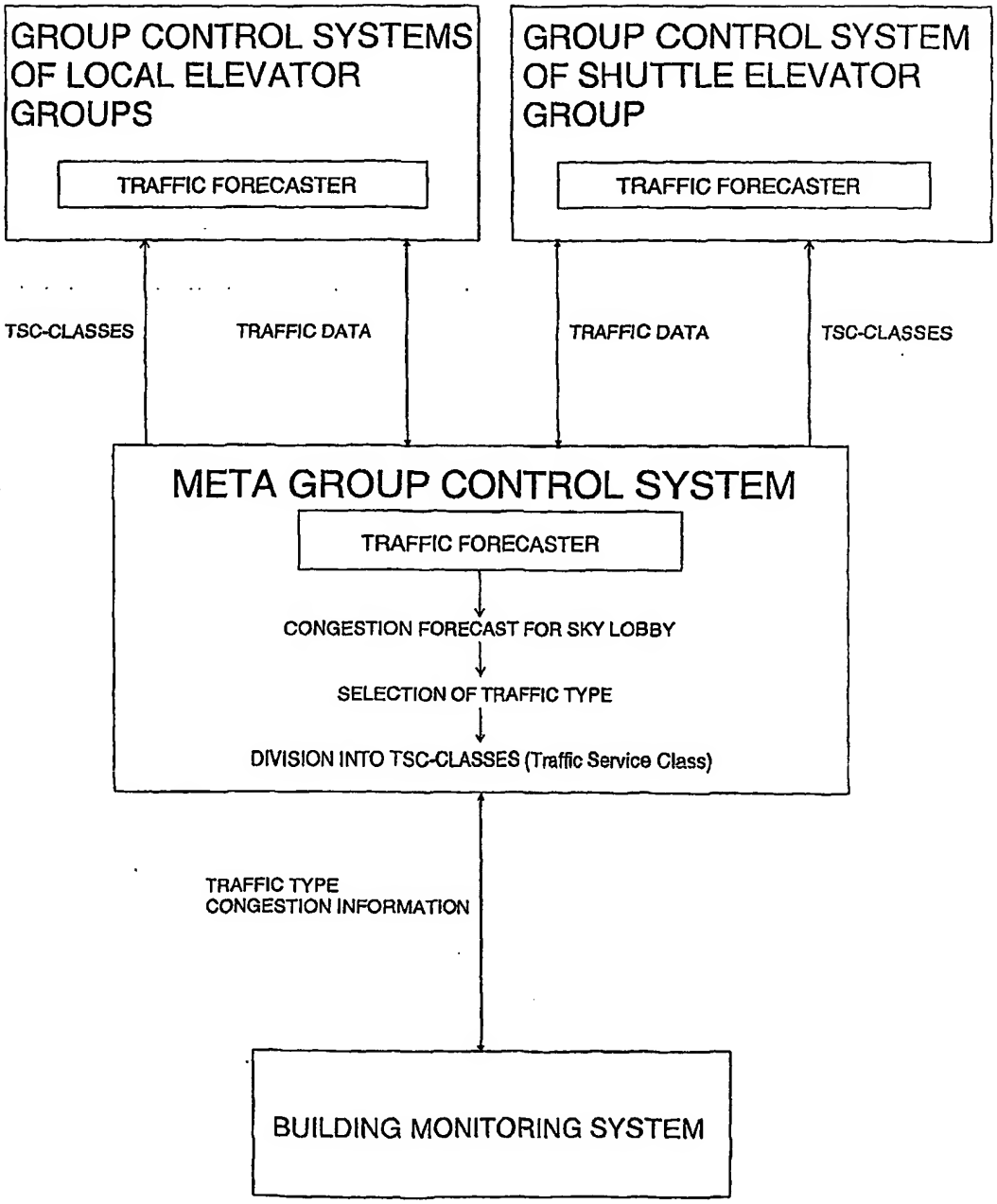


Fig. 2

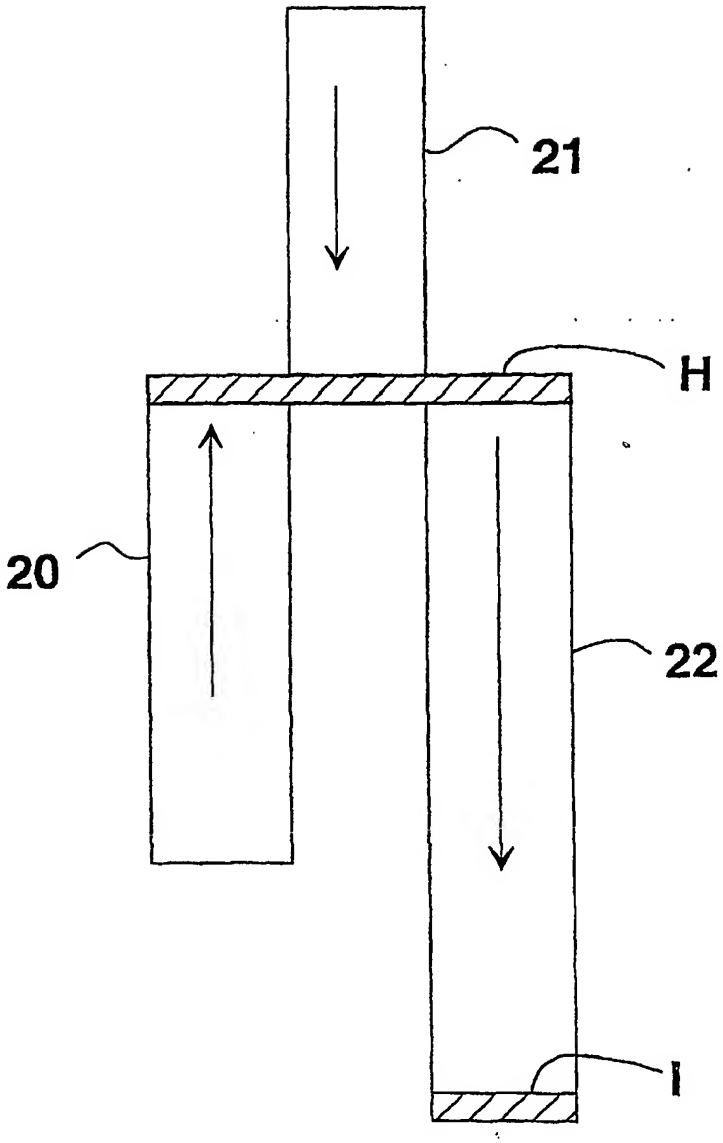


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 01/00574

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: B66B 1/20
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: B66B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4838385 A (RALF EKHOLM), 13 June 1989 (13.06.89), column 2, line 4 - line 49; column 3, line 12 - line 49; column 4, line 49 - line 56, column 4, line 65 - column 5, line 53	1,2
Y		3-6
A		10-14,7-9
	--	
Y	WO 9832683 A1 (KONE OY), 30 July 1998 (30.07.98), page 4, line 27 - page 5, line 2; page 5, line 17 - page 6, line 29	3-5
A		7,9-14
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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means
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"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 October 2001	12. 11. 2001

Name and mailing address of the International Searching Authority
European Patent Office P.B. 5818 Patentlaan 2
NL-2280 HV Rijswijk
Tel(+31-70)340-2040, Tx 31 651 epo nl,
Fax(+31-70)340-3016

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 01/00574

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 0427992 A2 (KONE ELEVATOR GMBH), 22 May 1991 (22.05.91), page 1, line 13 - line 40, abstract --	6
Y	US 5785153 A (BRUCE A. POWELL ET AL), 28 July 1998 (28.07.98), column 1, line 45 - column 2, line 3, abstract -- --------	10-14

INTERNATIONAL SEARCH REPORT

Information on patent family members

01/10/01

International application No.
PCT/FI 01/00574

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